Space Weather Technical Forecast

Issued on Tuesday, 06 February 2024 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares expected, with a chance of isolated X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate, with two M-class flares observed, peaking M2.1 at 05/0428 UTC, both from AR3576, and a number of C-flares. There are thirteen sunspot regions however a number of these are small and either stable or fading with only two of particular note. AR3576 is a large and active region on the southeast disc, with a complex but ragged main leader including a strong delta spot and significant magnetic looping evident in SDO imagery. AR3575 is a less active region in the southwest disc, which is becoming hard to assess due to both its southern and western location, however this consists of two main opposite polarity umbrae within a combined penumbra, leading to a further delta-configuration.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1 were indicative of the onset of a weak fast wind, likely from CH96/+. Initially near background, at around 400 km/s, these rose from 05/1500 UTC to become slightly elevated at just under 500km/s. Density was mostly average or below throughout. Interplanetary Magnetic field (IMF), Bt, was initially weak at 5-7nT, but gradually rose to be moderate at 8-11nT. The north-south component Bz, was mainly positive (northward) with brief negative rotations (southward) ranging between +8nT and -9nT. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is at background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. At 06/0000UTC the 24-hour integrated fluence observation was 1.6e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity expected, with further M-flares and a chance of X-flares. These most likely from either AR3576 in the southeast, or from AR3575 in the southwest. Although this risk decreases slightly day 3 onward as AR3575 recedes on the far-side.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Current fast winds from CH96 are expected to gradually ease days 1-2 (06-07 Feb), with slightly elevated speeds easing to background. No other enhancements forecast. Geomagnetic activity is expected to be mostly Quiet with a chance of Unsettled intervals, mainly days 1-2 (06-07 Feb).

Energetic Particles / Solar Radiation: High energy proton flux has the potential to rise in response to any significant flares. This most likely from AR3575 at first, but increasingly from AR3576 as this moves into a more central location. This bring a slight chance of exceeding the S1 Minor Radiation Storm level. High energy electron flux (greater than 2MeV) is expected to remain mostly at background with the associated 24 hour fluence persisting below the Active threshold.

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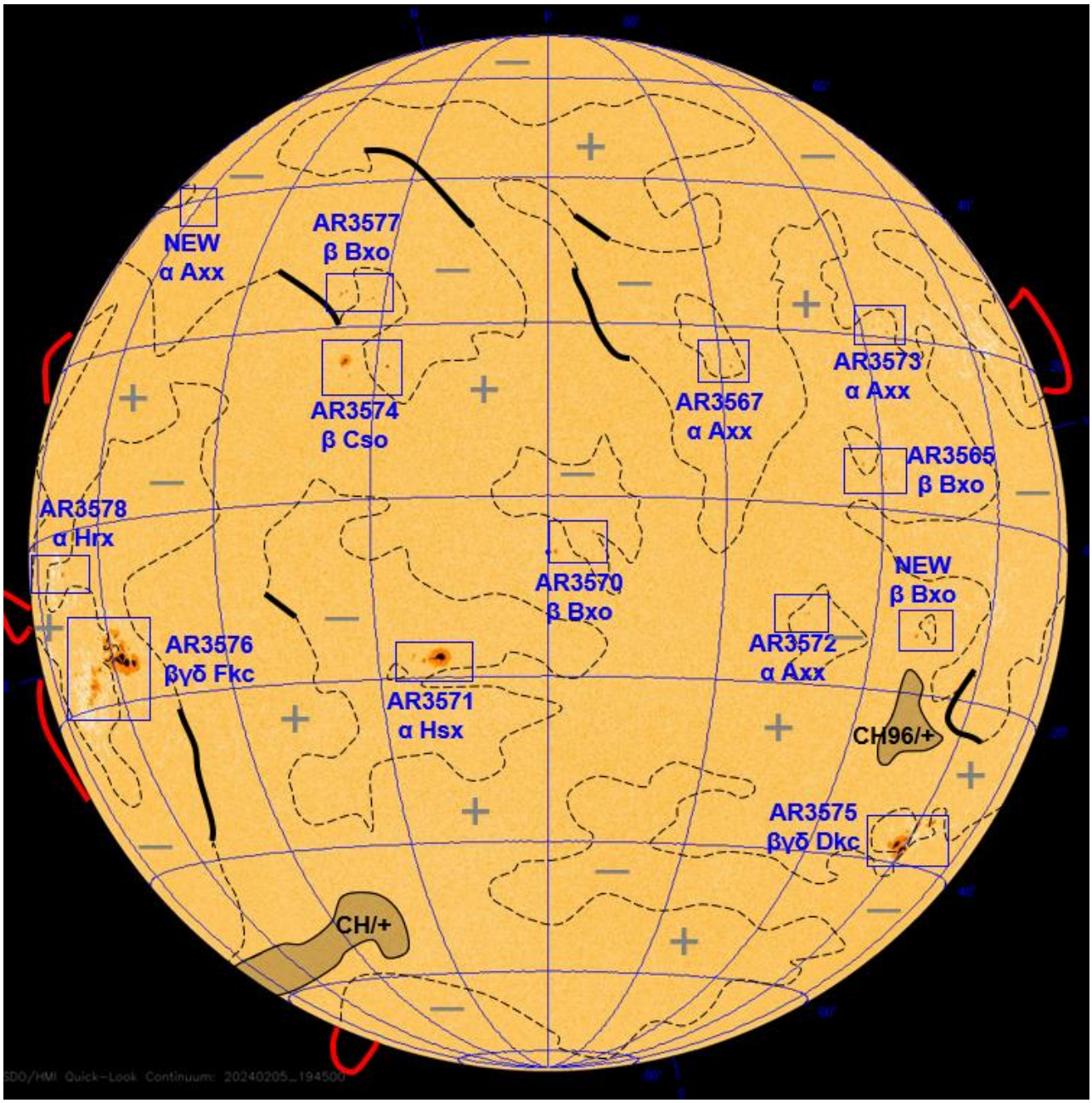
Figure 1. Solar Analysis Valid 05/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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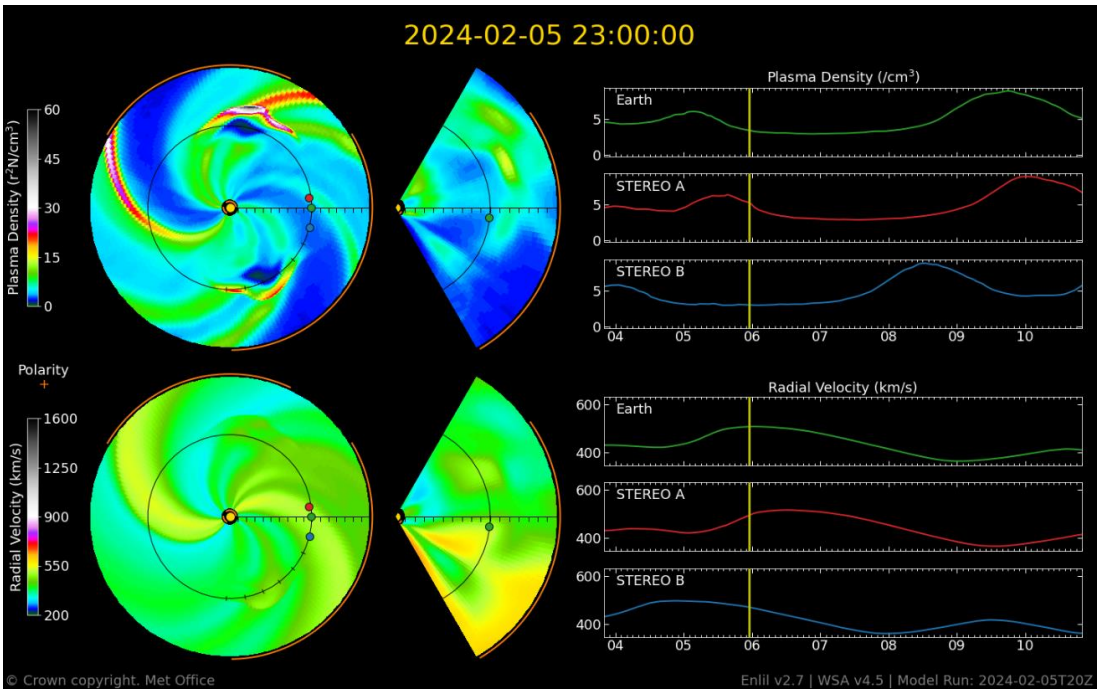
Geomagnetic Storms:

There are no Earth-directed CMEs.

Ongoing fast wind from small and now largely obscured coronal hole 96 is expected to gradually ease later day 1 and into day 2 (06-07 Feb), with solar winds falling from slightly elevated at around 500km/s to background, below 400 km/s. Mainly Quiet geomagnetic activity is forecast, with chance of isolated Unsettled intervals, mainly day 1-2 (06-07 Feb).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Current MOSWOC Enlil showing no further significant enhancements expected



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Radio Blackouts - X-Ray Flares:

Moderate activity is expected to continue with a chance of rising to High due to isolated X-class flares. The main risks for flaring are from AR3576 in the southeast and AR3575 approaching the southeast limb. There are thirteen active regions currently on the disc, however the majority are small, stable and simple with some of these spots showing signs of fading. The exceptions are the two spots mentioned, as well as two small emergent regions, AR3577 in the northeast and an unnumbered region in the southwest.

AR3576 is a large region in the southeast disc and the source of the majority of recent M-flare activity. Despite a rather ragged appearance and a recent reduction in activity, this has a strong delta within its main leader spot, with a broad area of looping evident in SDO-aia imagery. Along with an identifiable flux-rope and ongoing dynamical changes, this suggests the ongoing risk of notable flares. AR3575, while smaller, less active, and rotating over the southwest horizon late day 2 (07 Feb), also has a visible delta spot, along with some evidence of magnetic looping building within its canopy. Furthermore, any apparent reduction in spot area maybe due to its southern location, along with it approaching the western limb leading to an oblique viewing angle. Consequently notable flares also remain possible from this region.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	70	60
Very Active	R3 to R5 X Class	No	30	30	20	15

Figure 3a: GOES-16/18 X-ray Flux

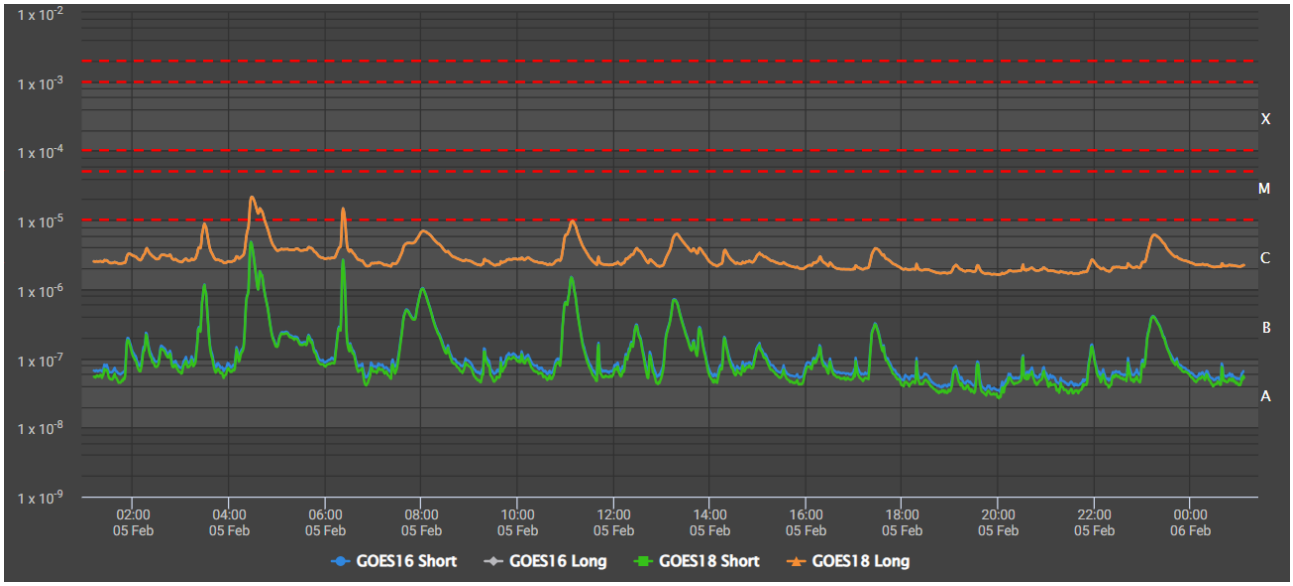

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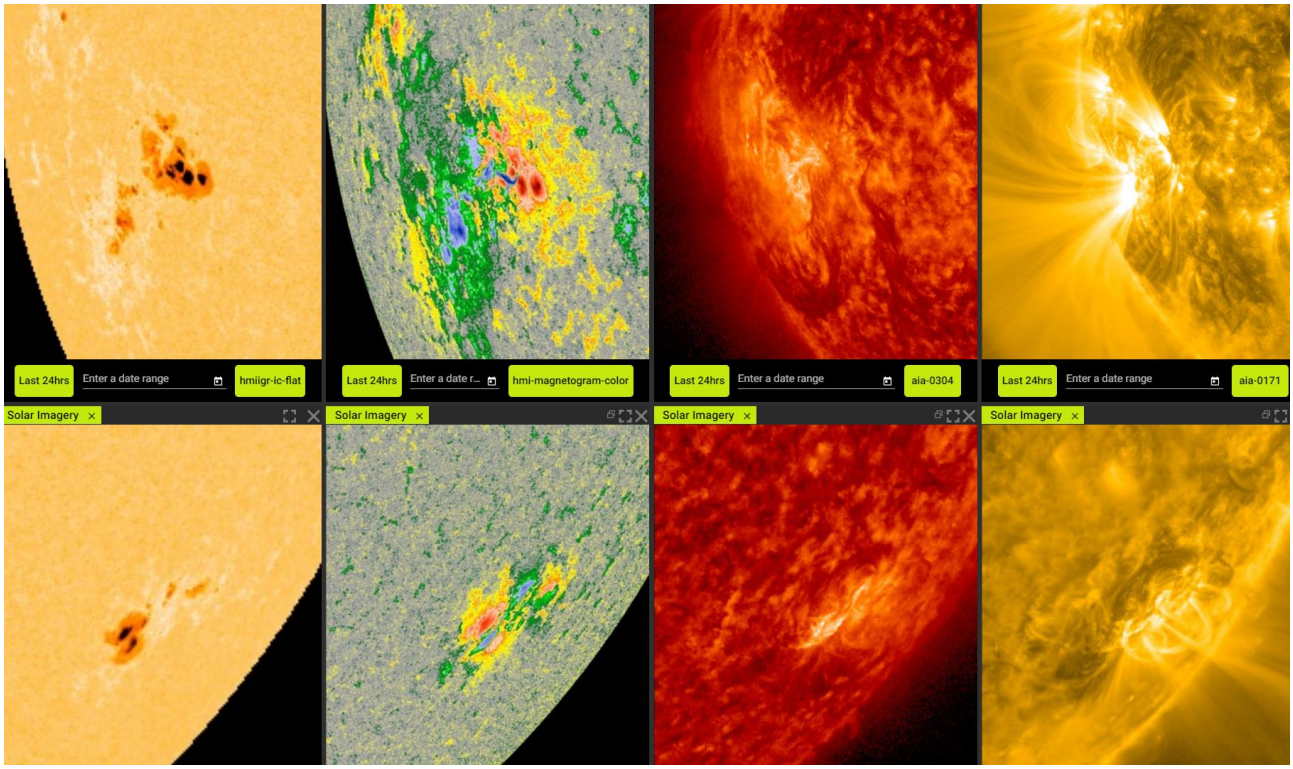
Figure 3b: SDO imagery of AR3575 (top) and AR3576 (bottom). Left to right – Intensitygram, Magnetogram, SDO-304 and SDO-171



Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently at background. There is a chance of proton flux rising in response to any notable flares, with a slight chance of exceeding the S1 Minor Radiation storm level. Initially the main risk is from AR3575, which is a moderately sized region in the southwest disc, however as this moves over the western horizon later on day 2 and day 3 (07 Dec) this risk will gradually reduce. However, AR3576, which is currently in the eastern disc, will have moved to a more central disc location, increasing the potential for proton events occurring due to any notable flares from this region.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected to persist at background, with the current fast wind enhancement unlikely to bring a notable increase in electron flux. There is a slight chance of brief Moderate flux day 2 (07 Feb) onward during the diurnal peak.

The associated 24 hour electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, as suggested by MOSWOC's REFM, which is currently giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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